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(71) Applicant(s)

United Kingdom Atomic Energy Authority

(Incorporated in the United Kingdom)

Harwell Laboratory, DIDCOT, Oxfordshire, OX11 0RA,
United Kingdom

(72) Inventor(s)

Michael John Davies

Norman Jorgensen

John Sydney Carlow

David Raybone

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(56) Documents Cited

GB 1042171 A

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US 5155994 A

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ONLINE DATABASES: WPI AND CLAIMS

(74) Agent and/or Address for Service

Paul Austin Wood

United Kingdom Atomic Energy Authority,

Patents Department, Building 329,

Harwell Laboratory, DIDCOT, Oxfordshire, OX11 0RA,

United Kingdom

(54) The purification of internal combustion engine exhaust emissions

(57) A method and apparatus for enhancing the catalytic reduction of exhaust gas pollutants during the warm-up phase of a cycle of use of an internal combustion engine, in which a plasma discharge 7 is initiated in the exhaust gas upstream of a catalytic converter 2 which forms part of an exhaust system. In a second embodiment the plasma is controlled by use of sensors detecting the temperature of the catalyst and the gas pressure and flow rate.

Fig. 1.

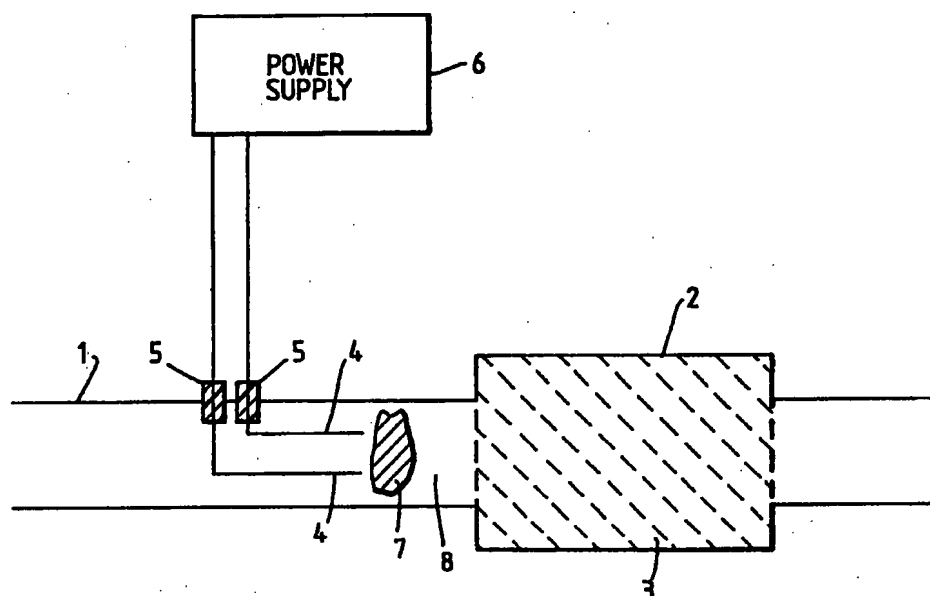
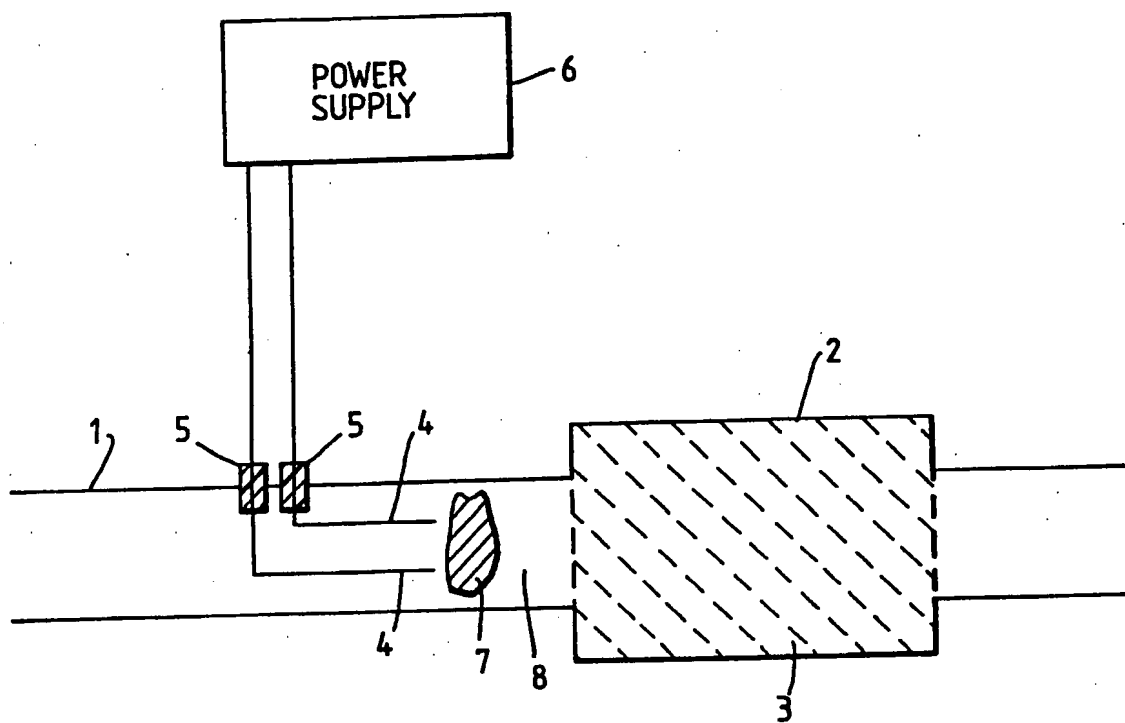
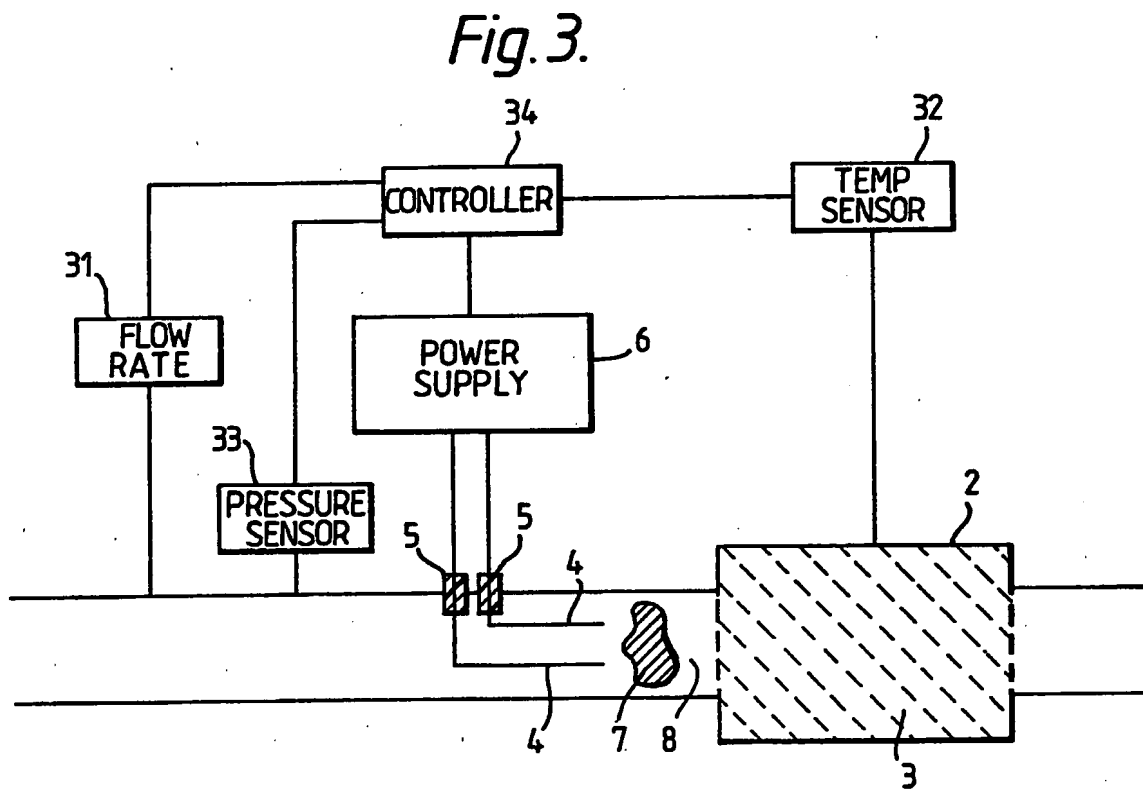
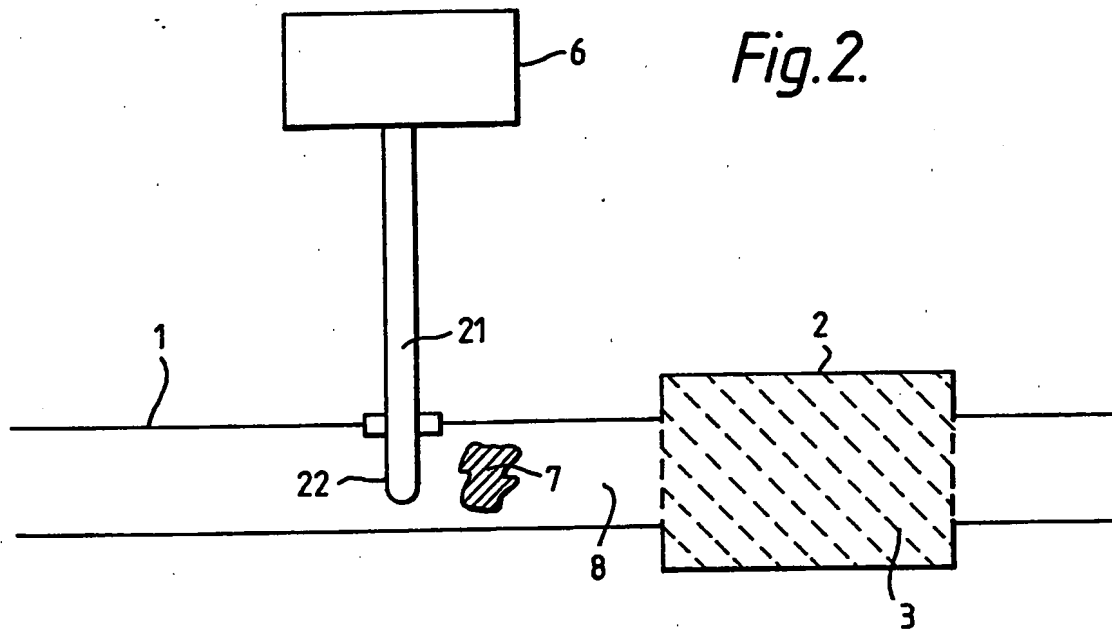


Fig. 1.





The Purification of Internal Combustion Engine
Exhaust Emissions

5 The present invention related to the purification of
the exhaust emissions from internal combustion engine
exhausts.

10 Increasingly, international concerns about the
environment are causing Governments to introduce
legislation to control and, where possible, reduce the
emission of pollutants arising from the combustion
processes in internal combustion engines. Pollutants of
concern include nitrogen oxides, unburnt hydrocarbons and
carbon particles.

15 The use of catalysts to reduce significantly the
emission of undesirable components of exhaust gases is
well known and they are in widespread use.

20 However, in general, the catalysts used at present
are effective only at temperatures greater than about
350°C. The combustion processes in an internal
combustion engine also are least efficient before the
engine has reached its normal operating temperature.
25 Thus, at the time when the emission of pollutants is at
its highest, the efficiency of the catalysts are at their
lowest.

30 It is an object of the present invention to provide
a method of and apparatus for improving the efficiency of
catalytic systems for purifying internal combustion
engine exhaust emissions in the early part of the
operating cycle of such engines.

35 According to the invention there is provided a
method of purifying the exhaust emissions from internal

combustion engines, including the operation of passing the exhaust emissions through a convertor including a medium adapted to catalyse the conversion of pollutants included in the exhaust emissions into less noxious substances, wherein there is included the operation of
5 subjecting the exhaust emissions to a low-temperature electrical discharge prior to passing the exhaust emissions through the convertor at least during an initial phase of the operation of an internal combustion engine with which the converter is associated.

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Also according to the invention there is provided a catalyst activity enhancer for use with an exhaust system for an internal combustion engine incorporating a converter including a medium adapted to catalyse the
15 conversion of pollutants included in the exhaust emissions from the internal combustion engine into less noxious substances, comprising means whereby an electrical discharge can be established in the said exhaust emissions prior to their entry into the
20 converter.

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The means whereby an electrical discharge can be established in the exhaust emissions may comprise a system of electrodes or, a microwave injector, or an
25 antenna. A suitable form of electrical discharge is a low temperature plasma.

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The invention will now be described, by way of example, with reference to the accompanying drawings in
30 which Figure 1 is a schematic representation of an embodiment of the invention.

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Figure 2 is a schematic representation of a second embodiment of the invention, and

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Figure 3 is a schematic representation of another embodiment of the invention.

Referring to Figure 1 of the drawings, there is shown a portion of an internal combustion engine exhaust system 1 including a section 2 which is a conventional catalytic converter including a catalytic material 3. Upstream of the catalytic converter 2 is a pair of electrodes 4 which are isolated from the exhaust system 1 by means of ceramic feed-throughs 5. The electrodes 4 are connected to a high voltage power supply 6 the output voltage from which is sufficient to create a plasma 7 in exhaust gases 8 flowing through the exhaust system 1.

As already mentioned, normally the catalyst 3 is at its least efficient at the very stage in the operating cycle of the internal combustion engine (not shown in the drawing) when the level of pollutants in the exhaust gases 8 is at its highest. The ionised species, electrons and free radicals in the exhaust gases 8 created by the plasma are very reactive and this compensates for the low level of activity of the catalyst 3.

Figure 2 shows a second embodiment in which the electrodes 4 are replaced by an antenna 21 to which power is supplied via a waveguide 22. The remainder of the system is unchanged and therefore the same reference numerals are used as for the embodiment of Figure 1.

In a more sophisticated system, which is illustrated in Figure 3, parameters of the exhaust gases 8, such as flow rate, temperature and pressure are monitored by sensors 31, 32 and 33, respectively and the operation of the power supply is varied by means of a controller 34 to ensure that the plasma 7 is maintained

until the catalyst 3 is at an efficient working temperature. Again, those components of the system which are the same as for the Figure 1 embodiment bear the same reference numerals.

Claims

1. A method of purifying the exhaust emissions from internal combustion engines, including the operation of passing the exhaust emissions through a convertor including a medium adapted to catalyse the conversion of pollutants included in the exhaust emissions into less noxious substances, wherein there is included the operation of subjecting the exhaust emissions to a low-temperature electrical discharge prior to passing the exhaust emissions through the convertor at least during an initial phase of the operation of an internal combustion engine with which the converter is associated.
2. A method according to Claim 1 wherein there is included the operations of monitoring the pressure and flow rate of the exhaust emissions from the internal combustion engine and the temperature of the medium adapted to catalyse the conversion of pollutants included in the exhaust emissions into less noxious substances, varying the operation of a power supply so as to maintain the electrical discharge in response to signals indicative of the pressure and flow rate of the exhaust emissions until the catalytic medium reaches a pre-determined value.
3. A method according to Claim 1 or Claim 2 wherein the electrical discharge is a low temperature plasma.
4. A catalyst activity enhancer for use with an exhaust system for use with an internal combustion engine incorporating a converter including a medium adapted to catalyse the conversion of pollutants included in the exhaust emissions from the internal combustion engine into less noxious substances, comprising means whereby an electrical discharge can be established in the said

exhaust emissions prior to their entry into the converter.

5. A catalytic activity enhancer according to Claim 4
5 wherein there is included means for measuring the flow rate of the said exhaust emissions and generating signals related thereto, means for measuring the pressure of the said exhaust emissions and generating signals related thereto, means for measuring the temperature of the
10 catalytic medium and generating signals relating thereto and a controller responsive to the said signal to vary the action of a power supply adapted to provide the power to maintain the electrical discharge in the said exhaust emissions in such a manner as to maintain the electrical
15 discharge until the catalytic medium reaches a pre-determined temperature.

6. A catalytic activity enhancer according to Claim 4
or Claim 5 wherein the means for establishing an
20 electrical discharge in the exhaust emissions a system of electrodes.

7. A catalytic activity enhancer according to Claim 4
or Claim 5 wherein the means for establishing an
25 electrical discharge in the exhaust emissions comprises means for establishing a microwave electromagnetic field in the exhaust emissions thereby to create a plasma in the exhaust emissions.

30 8. A catalytic activity enhancer according to Claim 7 wherein the means for establishing a microwave electromagnetic field in the exhaust emissions comprises an antenna.

35 9. A method of purifying the exhaust emissions from an internal combustion engine substantially as hereinbefore

described and with reference to the accompanying drawings.

10. A catalytic activity enhancer for use in purifying
5 the exhaust emissions from internal combustion engines
substantially as hereinbefore described and with
reference to the accompanying drawings.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

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Search Examiner
 J H WARREN

Date of completion of Search
 9 November 1993

Databases (see below)
 (i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-
 1-10

(ii) ONLINE DATABASES: WPI and CLAIMS

Categories of documents

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|---|---|
| X: Document indicating lack of novelty or of inventive step. | P: Document published on or after the declared priority date but before the filing date of the present application. |
| Y: Document indicating lack of inventive step if combined with one or more other documents of the same category. | E: Patent document published on or after, but with priority date earlier than, the filing date of the present application. |
| A: Document indicating technological background and/or state of the art. | &: Member of the same patent family; corresponding document. |

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 1042171 A	(MATVAY) - Plasma 25, catalytic lining 195	1,3,4,6
X	WO 92/19361 A1	(PLASMACHINES) - page 4 line 31-page 8 line 2	1,3,4,6
Y	US 5155994 A	(TOYOTA) - Figure 2, column 7 lines 31-36)	1,3,4,6
Y	US 3983021 A	(MONSANTO) - whole document, especially column 1 lines 1-27	1,3,4,6

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).